FORMPTO-1390(Modified) (REV11-98) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE **TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371**	ATTORNEY'S DOCKET NUMBER 112740-112
	U.S. APPLICATION NO. (IF KNOWN SEE 37 CFR 09/647431

INTERNATIONAL APPLICATION NO. PCT/DE99/00783	INTERNATIONAL FILING DATE 19 March 1999	PRIORITY DATE CLAIMED 07 April 1998

TITLE OF INVENTION
METHOD AND APPARATUS FOR COUPLING AN ATM COMMUNICATION LAYER TO A PLURALITY OF TIME-DIVISION MULTIPLEX COMMUNICATION TERMINALS

APPLICANT(S) FOR DO/EO/US
Andreas Klug

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C 371.

2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.

3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).

4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))

    a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).

    b. ☐ has been transmitted by the International Bureau.

    c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).

6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).

7. ☒ A copy of the International Search Report (PCT/ISA/210).

8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))

    a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).

    b. ☐ have been transmitted by the International Bureau.

    c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.

    d. ☐ have not been made and will not be made.

9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).

11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).

12. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

14. ☒ An assignment document for recording A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

15. ☒ A **FIRST** preliminary amendment.

16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.

17. ☐ A substitute specification.

18. ☒ A change of power of attorney and/or address letter.

19. ☒ Certificate of Mailing by Express Mail

20. ☒ Other items or information:

Submission of Drawings Fig. 1 on one sheet

PCTUS1/REV03

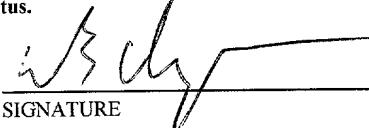| U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 09/647431	INTERNATIONAL APPLICATION NO. PCT/DE99/00783	ATTORNEY'S DOCKET NUMBER 112740-112

21. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS	PTO USE ONLY
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO $970.00			
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but Internation Search Report prepared by the EPO or JPO $840.00			
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $690.00			
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) $670.00			
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) $96.00			

ENTER APPROPRIATE BASIC FEE AMOUNT =	$0.00	$860.00
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	$0.00	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	- 20 =	0	x $18.00	$0.00	
Independent claims	- 3 =	0	x $78.00	$0.00	
Multiple Dependent Claims (check if applicable) .			☐	$0.00	

TOTAL OF ABOVE CALCULATIONS =	$0.00	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable)** . ☐	$0.00	
SUBTOTAL =	$0.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +	$0.00	
TOTAL NATIONAL FEE =	$0.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐	$0.00	
TOTAL FEES ENCLOSED =	$0.00	$860.00

Amount to be: refunded	$
charged	$

☒ A check in the amount of **$860.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees.
   A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **02-1818** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

William E. Vaughan
Bell, Boyd & Lloyd LLC
P.O. Box 1135
Chicago, IL 60690-1135

SIGNATURE

William E. Vaughan
NAME

39,056
REGISTRATION NUMBER

October 2, 2000
DATE

BOX PCT

IN THE UNITED STATES ELECTED OFFICE

OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

UNDER THE PATENT COOPERATION TREATY-CHAPTER II

PRELIMINARY AMENDMENT

APPLICANT: Andreas Klug   DOCKET NO: 112740-112

SERIAL NO: GROUP ART UNIT:

     EXAMINER:

INTERNATIONAL APPLICATION NO: PCT/DE99/00783

INTERNATIONAL FILING DATE: 19 March 1999

INVENTION: METHOD AND APPARATUS FOR COUPLING AN ATM COMMUNICATION LAYER TO A PLURALITY OF TIME-DIVISION MULTIPLEX COMMUNICATION TERMINALS

Assistant Commissioner for Patents,
Washington, D.C. 20231

Sir:

Please amend the above-identified International Application before entry into the National stage before the U.S. Patent and Trademark Office under 35 U.S.C. §371 as follows:

In The Specification:

On page 1 cancel lines 1-3 and substitute the following therefor:

--**S P E C I F I C A T I O N**

TITLE

METHOD AND APPARATUS FOR COUPLING AN ATM COMMUNICATION LAYER TO A PLURALITY OF TIME-DIVISION MULTIPLEX COMMUNICATION TERMINALS

BACKGROUND OF THE INVENTION

Field of the Invention--.

On page 1, line 4, insert --present-- before "invention".

On page 1, line 4, insert --both-- before "a".

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On page 1, line 4, cancel "to".

On page 1, line 6, insert --such that, in particular, all losses are avoided and the variation of the cell delay is minimized--after "terminals".

On page 1, before line 7, insert the following left-hand justified heading:

--**Description of the Prior Art**--.

On page 1, line 7, cancel "are" and substitute therefor --is--.

On page 1, line 11, insert a --,-- after "asynchronously".

On page 1, line 11, insert a --,-- after "dependent".

On page 1, line 19, cancel "thereby".

On page 1, line 21, cancel "I.e." and substitute therefor --That is--.

On page 1, line 22, cancel "dare" and substitute therefor --should--..

On page 1, line 22, cancel "greatly".

On page 1, line 28, cancel "list" and substitute therefor --lists--.

On page 2, line 15, insert --present-- before "invention".

On page 2, line 15, cancel "based on the problem of proposing" and substitute therefor --, therefore, directed to--.

On page 2, line 16, cancel "realizing the".

On page 2, line 16, cancel "of" after "coupling"..

On page 2, before line 19, insert the following centered heading:

--**SUMMARY OF THE INVENTION**--.

On page 2, cancel lines 19-29 and substitute the following therefor:

--Accordingly, in an embodiment of the present invention, a method is provided for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals having an overall payload cell rate CR_N wherein the method includes the steps of: generating a control signal sequence with a clock rate corresponding to the overall payload cell rate CR_N of the N time-division multiplex communication terminals, whereby the control signals represent one of a first and a second status; offering a fixed data pattern; transmitting

ATM cells coming from the ATM communication layer into an ATM cell waiting list; transmitting, on demand, an ATM cell from the ATM waiting list to the requesting time-division multiplex communication terminal when a respectively oldest control signal of the control signal sequence represents the first status, and transmitting the fixed data pattern to the requesting time-division multiplex communication terminal when the oldest control signal of the control signal sequence represents the second status; and deleting the oldest control signal of the control signal sequence.

In an embodiment, the method further includes the steps of: allocating a control signal that represents the first status to each ATM cell of the ATM waiting list in the control signal sequence; carrying out a check, when a new control signal of the control signal sequence is generated in coincidence with the prescribed clock rate, to see whether an ATM cell to which no control signal representing the first status is allocated is still present in the ATM waiting list; generating a control signal representing the first status when an ATM cell to which no control signal representing the first status is allocated is still present in the ATM waiting list; and generating a control signal representing the second status when an ATM cell to which no control signal representing the first status is allocated is not present in the ATM waiting list.

In an embodiment of the method, the control signal representing the first status is represented by a logical "1" and the control signal representing the second status is represented by a logical "0".

In an embodiment of the method, the control signal sequence has a length of up to $3 \cdot N$ signals.

In an embodiment, the method further includes the step of enabling a cell transmission from the ATM communication layer into the ATM waiting list when the plurality of ATM cells present in the waiting list minus the plurality of control signals of the control signal sequence representing the first status is $\leq X$.

In an embodiment of the method, $X \geq 1$.

In an embodiment of the method, $X = 1$.

In an embodiment of the method, the N time-division multiplex terminals are uncorrelated.

In an embodiment, the method further includes the step of dividing the ATM cells and the cells containing the fixed data pattern onto the N communication terminals according to a round-robin method.

In a further embodiment of the present invention, an apparatus is provided for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals having an overall payload cell rate CR_N, wherein the apparatus includes: a generator for generating a control signal sequence with a clock rate corresponding to the overall payload cell rate CR_N of the N time-division multiplex communication terminals, whereby the control signals represent one of a first and a second status; a device for offering a fixed data pattern; a first transmitter for transmitting ATM cells coming from the ATM communication layer into an ATM cell waiting list; a second transmitter for transmitting an ATM cell from the ATM waiting list to a requesting time-division multiplex communication terminal when a respectively oldest control signal of the control signal sequence represents the first status, and transmitting the fixed data pattern to the requesting time-division multiplex communication terminal when the oldest control signal of the control signal sequence represents the second status; and a device for deleting the oldest control signal of the control signal sequence.

On page 3, cancel lines 1-5.

On page 3, line 14, insert a --,-- after "equal".

On page 3, line 14, insert a --,-- after "average".

On page 3, line 15, cancel "Dependent" and substitute therefor -- Depending--.

On page 3, line 25, cancel "; otherwise" and substitute therefor --.
Otherwise--.

On page 4, line 7, cancel "greatly".

On page 4, line 9, insert --either-- before "completely".

On page 4, line 11, cancel "ensue" and substitute therefor --occur--.

On page 4, line 11, cancel "what is referred to as".

On page 4, line 11, cancel "round robin" and substitute therefor --round-robin--.

On page 4, cancel lines 13-15 and substitute the following therefor:

--Additional features and advantages of the present invention are described in, and will be apparent from, the Detailed Description of the Preferred Embodiments and the Drawings.

DESCRIPTION OF THE DRAWINGS

Figure 1 shows a schematic drawing exemplying the method of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

On page 4, line 16, cancel "The" and substitute therefor --Referring to Figure 1, the--.

On page 4, line 16, cancel "proceed" and substitute therefor --proceeds--.

On page 4, line 20, cancel "(at the right in the Figure)".

On page 4, line 27, cancel "ensues" and substitute therefor --occurs--.

On page 5, line 2, cancel "; when" and substitute therefor --. When--.

On page 5, line 4, cancel "ensues" and substitute therefor --occurs--.

On page 5, line 4, cancel "round robin" and substitute therefor --round-robin--..

On page 5, line 9, cancel "this means that".

On page 5, line 10, cancel "enables".

On page 5, line 11, insert --is enabled-- after "list".

On page 5, after line 21, insert the following paragraph:

--Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.--

On page 9 (last page), cancel lines 1-3 and substitute the following centered heading therefor:

<div align="center">

--**ABSTRACT OF THE DISCLOSURE**--.

</div>

On page 9, line 4, insert -- and apparatus-- after "method".

On page 9, line 6, cancel "comprises the steps of" and substitute therefor --which involves--.

On page 9, cancel line 22.

In the Claims:

On page 6, cancel line 1, and substitute the following left-hand justified heading therefor:

--I **Claim As My Invention**--.

Please cancel claims 1-10, without prejudice, and substitute the following claims therefor:

11.   A method for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals having an overall payload cell rate CR_N, the method comprising the steps of:

generating a control signal sequence with a clock rate corresponding to the overall payload cell rate CR_N of the N time-division multiplex communication terminals, whereby the control signals represent one of a first and a second status;

offering a fixed data pattern;

transmitting ATM cells coming from the ATM communication layer into an ATM cell waiting list;

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transmitting, on demand, an ATM cell from the ATM waiting list to the requesting time-division multiplex communication terminal when a respectively oldest control signal of the control signal sequence represents the first status, and transmitting the fixed data pattern to the requesting time-

5   division multiplex communication terminal when the oldest control signal of the control signal sequence represents the second status; and

deleting the oldest control signal of the control signal sequence.

12.   A method for coupling an ATM communication layer to a
10   plurality of N mutually time-independent time-division multiplex communication terminals as claimed in claim 11, the method further comprising the steps of:

allocating a control signal that represents the first status to each ATM cell of the ATM waiting list in the control signal sequence;

15   carrying out a check, when a new control signal of the control signal sequence is generated in coincidence with the prescribed clock rate to see whether an ATM cell to which no control signal representing the first status is allocated is still present in the ATM waiting list;

generating a control signal representing the first status when an
20   ATM cell to which no control signal representing the first status is allocated is still present in the ATM waiting list; and

generating a control signal representing the second status when an ATM cell to which no control signal representing the first status is allocated is not present in the ATM waiting list.

25

13.   A method for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals as claimed in claim 11, wherein the control signal representing the first status is represented by a logical "1" and the control
30   signal representing the second status is represented by a logical "0".

14.   A method for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals as claimed in claim 11, wherein the control signal sequence has a length of up to $3 \cdot N$ signals.

15.   A method for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals as claimed in claim 11, the method further comprising the step of enabling a cell transmission from the ATM communication layer into the ATM waiting list when the plurality of ATM cells present in the waiting list minus the plurality of control signals of the control signal sequence representing the first status is $\leq X$.

16.   A method for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals as claimed in claim 15, wherein $X \geq 1$.

17.   A method for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals as claimed in claim 16, wherein $X = 1$.

18.   A method for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals as claimed in claim 11, wherein the N time-division multiplex terminals are uncorrelated.

19.   A method for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals as claimed in claim 18, the method further

comprising the step of dividing the ATM cells and the cells containing the fixed data pattern onto the N communication terminals according to a round-robin method.

5   20.   An apparatus for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals having an overall payload cell rate CR_N , the apparatus comprising:

a generator for generating a control signal sequence with a clock
10   rate corrresponding to the overall payload cell rate CR_N of the N time-division multiplex communication terminals, whereby the control signals represent one of a first and a second status;

a device for offering a fixed data pattern;

a first transmitter for transmitting ATM cells coming from the ATM
15   communication layer into an ATM cell waiting list;

a second transmitter for transmitting an ATM cell from the ATM cell waiting list to a requesting time-division multiplex communication terminal when a respectively oldest control signal of the control signal sequence represents the first status, and transmitting the fixed data pattern to the
20   requesting time-division multiplex communication terminal when the oldest control signal of the control signal sequence represents the second status; and

a device for deleting the oldest control signal of the control signal sequence.

25   **REMARKS**

The present amendment makes editorial changes and corrects typographical errors in the specification in order to conform the specification to the requirements of the United States Patent practice. No new matter is added thereby. Original claims 1-10 have been canceled in favor of new
30   claims 11-20. However, claims 11-20 have been presented solely because

the revisions by bracketing and underlining which would have been necessary in claims 1-10 in order to conform those claims to the requirements of United States Patent practice would have been too extensive, and thus would have been too burdensome. The cancellation of claims 1-10 does not constitute an intent on the part of the Applicant to surrender any of the subject matter of claims 1-10.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

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1

METHOD AND APPARATUS FOR COUPLING AN ATM COMMUNICATION LAYER TO A PLURALITY OF TIME-DIVISION MULTIPLEX COMMUNICATION TERMINALS

The invention is directed to a method and to an apparatus for coupling an

5   ATM communication layer to a plurality of mutually independent time-division

multiplex communication terminals.

In the asynchronous transfer mode (ATM), data are transmitted in the

ATM layer in cells of 53 bytes (48 bytes payload data and 5 bytes control data)

independently of the information they represent (voice communication, data

10 communication, multimedia). The cells are thereby not transmitted continuously but

asynchronously or burst-by-burst dependent on the momentary demand for

transmission bandwidth.

In order to couple such a high-performance ATM layer to terminal points

or local networks, it is necessary to divide the cell stream of the ATM layer onto a

15 plurality of time-division multiplex communication terminals (ports) that are

independent of one another in terms of time. The problem of decoupling the time-

uncorrelated behavior of the ATM communication layer with [sic!] the time-

uncorrelated cell transmission demands of the plurality of time-division multiplex

communication terminals thereby arises. In order to thereby meet the real-time

20 demands made, for example, of the voice communication, an optimally favorable cell

delay variation (CDV) behavior must be assured. I. e., the time delay of individual

cells dare not fluctuate more greatly than a defined value in order to avoid a

falsification of the time sequence of cells in the transmission of successive cells via

different communication paths.

25   For a plurality N of time-division multiplex communication terminals, it is

known to generate a waiting list having a cell rate corresponding to N-times the cell

rate of the individual ports (assuming all ports have the same, typical transmission

bandwidth). The cells waiting list [sic] are then distributed onto the N terminals

according to what is referred to as the round-robin method. Those of the N terminals that request a cell at the moment are thereby successively serviced cell-by-cell by the waiting list in a fixed sequence. Since the N communication terminals are independent of one another in terms of time, it can occur that up to N cells are

5   simultaneously requested from the waiting list at a specific point in time. The coupling of the ATM communication layer must thus be able to "buffer" both the ATM bursts as well as the port-side fluctuations in the demand for cells. On the other hand, excessively long waiting lists lead to a deterioration of the cell delay variation behavior of the coupling.

10   The format and the specifications of the ATM layer are described, for example, in Rathgeb, Wallmeier, "ATM-Infrastruktur für die Hochleistungskommunikation", pp. 78-90, and the coupling to a plurality of time-division multiplex terminals is described in ATM-Forum, "Baseline Text for Inverse Multiplexing for ATM, AF-PHY-0086.000."

15   The invention is based on the problem of proposing a method and an apparatus for realizing the coupling of an ATM communication layer to a plurality of time-division multiplex communication terminals, whereby cell losses are avoided and the variation of the cell delay is minimized.

       The problem is solved by the method defined in claim 1 and by the

20   apparatus defined in claim 10. The method comprises the method steps:

--   generating a control signal sequence with a clock rate corresponding to the overall payload cell rate CR_N of the N time-division multiplex communication terminals, whereby the control signals can represent a first or a second status;

25   --   offering a fixed data pattern;

--   transmitting the ATM cells coming from the ATM communication layer into an ATM cell waiting list;

--   transmitting, on demand, an ATM cell from the ATM waiting list to the requesting time-division multiplex communication terminal when the

respectively oldest control signal of the control signal sequence represents the first status, and transmitting the fixed data pattern to the requesting time-division multiplex communication terminal when the oldest control signal of the control signal sequence represents the second status; and

5 -- deleting the oldest control signal of the control signal sequence.

As a result of the control signal sequence, a clocking of the transmission of the communication cells from the ATM waiting list to the requesting terminal (port) is prescribed that is independent of the asynchronous delivery of ATM cells into the ATM cell waiting list as well as of the non-uniform cell demand of the N

10 ports that are independent of one another in terms of time. The control signal sequence emulates a behavior of the time-uncorrelated communication terminals (physical layer) corresponding to a terminal with N-fold bandwidth. The clock rate is thereby selected corresponding to the overall bandwidth of the n ports, so that the plurality of cells generated in the N-port waiting list is equal on average to the cell

15 demand of the N ports. Dependent on whether an ATM cell is in the ATM waiting list or not, either this ATM cell or a fixed data pattern (stuffing cell) is transmitted. Which of the two cell contents is added to the N-port waiting list is dependent on the respectively oldest control signal of the control signal sequence. The control signal can thereby represent a first or a second status.

20 A control signal representing the first of the two statusses is preferably allocated to each cell in the ATM cell waiting list. A check to see whether a cell to which a control signal representing the first status has not yet been allocated is in the ATM waiting list is carried out at every point in time defined by the prescribed clock rate for generating a new control signal. When this is the case, a control signal, for

25 example a logical "1", representing the first status is generated; otherwise, a control signal, for example a logical "0", representing the second status is generated. The length of the control signal sequence can be selected according to the method of virtual chaining of the N communication ports and can, for example, amount to up to $3 \cdot N$ control signals.

The transmission of a cell from the ATM communication layer into the ATM waiting list is only enabled when the plurality of cells in the ATM waiting list minus the plurality of control signals representing the first status ("ones") is less than or equal to a number X. The lead time for the cell transmission from the ATM layer to the communication terminals can be set with X. X must be at least ≥ 1 in order to dependably assure the transmission of all cells. However, the lead time varies all the more greatly and the cell delay variation (CDV) behavior is all the poorer the higher X is set.

The N time-division communication terminals can be completely uncorrelated or partly correlated with one another. The division of the cells onto the N terminals can ensue according to what is referred to as the round robin method or a method that is suited dependent on the desired application.

An exemplary embodiment of the present invention is described on the basis of Figure 1, which shows a schematic illustration for explaining the functioning of the inventive method and of the inventive apparatus.

The data to be transmitted proceed from the ATM layer onto the ATM cell waiting list uncorrelated in time in units of ATM cells of 53 bytes. A clock generator circuit CLK generates clock pulses with a frequency that corresponds to the overall cell rate of all N time-division multiplex communication terminals that are connected (at the right in the Figure). At every point in time of a clock pulse, the inventive apparatus checks to see whether an ATM cell to which a control signal was not yet allocated is in the ATM cell waiting list. When this is the case, a logical "1" is entered into the control signal sequence as control signal. When no "new" ATM cell is in the waiting list, then a "0" is entered into the control signal sequence. This operation is repeated at every clock pulse from the clock generator circuit CLK, so that a "1" of the control signal sequence is allocated to every ATM cell in the ATM cell waiting list. When a cell request ensues from one of the N communication terminals, then the entry in the control signal sequence decides whether an ATM cell or a fixed data pattern F, what is referred to as a stuffing cell, is transmitted. When

the foremost (oldest) signal of the control signal sequence is a "1", then, for example, an ATM cell is transmitted; when it is a "0", then the stuffing cell F is transmitted. The division of the cells onto the N time-division multiplex communication terminals ensues according to the known round robin method. Subsequently, this oldest signal of the control signal sequence is deleted.

In order to avoid a cell loss, the inventive coupling device checks whether the plurality of ATM cells in the ATM waiting list minus the plurality of "ones" in the control signal sequence is less than or equal to x (with $x \geq 1$). When this is the case, this means that a maximum of one ATM cell to which a "1" has not yet been allocated in the control signal sequence is in the waiting list, and enables the transmission of ATM cells into the ATM waiting list. When the difference is greater, then the transmission is blocked until enough "ones" have again been generated in the control signal sequence.

The present invention thus enables an asynchronous coupling of an ATM communication layer to a plurality of mutually independent time-division multiplex communication terminals, whereby cell losses are avoided and the cell delay time variation is kept to a minimum at the same time. The control signal sequence emulates a behavior of the N mutually time-independent communication terminals like a terminal with the overall bandwidth of all N terminals. As a result thereof, bursts of the ATM layer and burst-like behavior of the time-uncorrelated terminal are decoupled from one another.

Patent Claims

1. Method for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals having an overall payload cell rate CR_N, comprising the steps:

5   --   generating a control signal sequence with a clock rate corresponding to the overall payload cell rate CR_N of the N time-division multiplex communication terminals, whereby the control signals can represent a first or a second status;

   --   offering a fixed data pattern;

10   --   transmitting the ATM cells coming from the ATM communication layer into an ATM cell waiting list;

   --   transmitting, on demand, an ATM cell from the ATM waiting list to the requesting time-division multiplex communication terminal when the respectively oldest control signal of the control signal sequence represents

15   the first status, and transmitting the fixed data pattern to the requesting time-division multiplex communication terminal when the oldest control signal of the control signal sequence represents the second status; and

   --   deleting the oldest control signal of the control signal sequence.

2. Method according to claim 1, characterized in that a control signal that

20 represents the first status is allocated to each ATM cell of the ATM waiting list in the control signal sequence, and whereby, when a new control signal of the control signal sequence is generated in coincidence with the prescribed clock rate, a check is carried out to see whether an ATM cell to which no control signal representing the first status is allocated is still present in the ATM waiting list, and a control signal representing

25 the first status is generated in this case and, otherwise, a control signal representing the second status is generated.

3. Method according to claim 1 or 2, characterized in that the control signal representing the first status is represented by a logical "1" and the control signal representing the second status is represented by a logical "0".

4. Method according to one of the claims 1 through 3, characterized in that the control signal sequence has a length of up to 3·N signals.

5. Method according to one of the claims 1 through 4, characterized in that a cell transmission from the ATM communication layer into the ATM waiting list is enabled when the plurality of ATM cells present in the waiting list minus the plurality of control signals of the control signal sequence representing the first status is ≤ X.

6. Method according to claim 5, characterized in that X ≥ 1 applies.

7. Method according to claim 6, characterized in that X = 1 applies.

8. Method according to one of the claims 1 through 7, characterized in that the N time-division multiplex terminals are uncorrelated.

9. Method according to claim 8, characterized in that the ATM cells and the cells containing the fixed data pattern are divided onto the N communication terminals according to the round robin method.

10. Apparatus for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals having an overall payload cell rate CR_N, comprising:
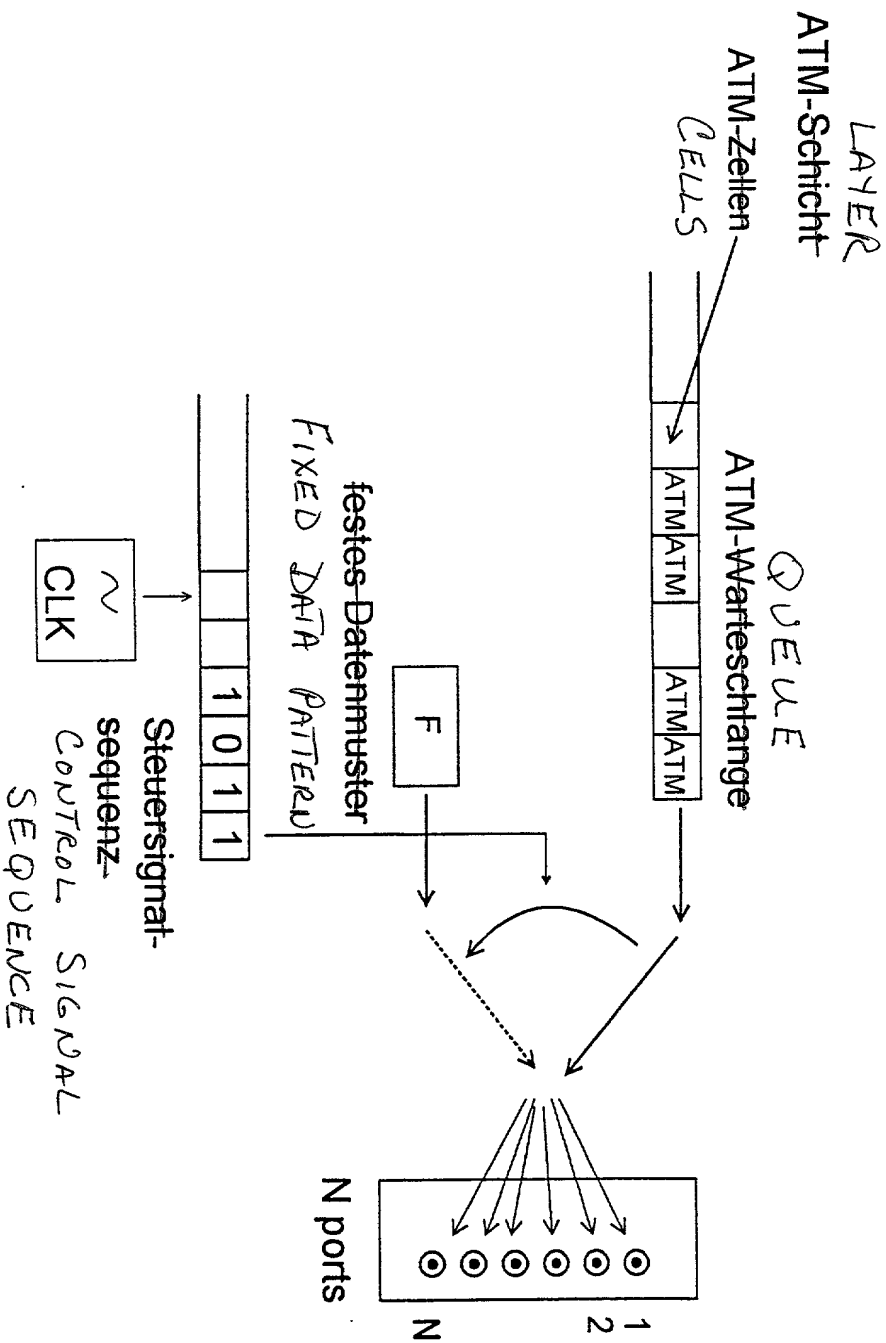
-- a means for generating a control signal sequence with a clock rate corresponding to the overall payload cell rate CR_N of the N time-division multiplex communication terminals, whereby the control signals can represent a first or a second status;

-- a means for offering a fixed data pattern;

-- a means for transmitting the ATM cells coming from the ATM communication layer into an ATM cell waiting list;

-- a means for transmitting an ATM cell from the ATM waiting list to a requesting time-division multiplex communication terminal when the respectively oldest control signal of the control signal sequence represents the first status, and transmitting the fixed data pattern to the requesting time-division multiplex communication terminal when the oldest control signal of the control signal sequence represents the second status; and

-- a means for deleting the oldest control signal of the control signal sequence.

Abstract

Method and Apparatus for Coupling an ATM Communication Layer to a Plurality of Time-Division Multiplex Communication Terminals

A method for coupling an ATM communication layer to a plurality of N mutually time-independent time-division multiplex communication terminals having an overall payload cell rate CR_N comprises the steps: generating a control signal sequence with a clock rate corresponding to the overall payload cell rate CR_N of the N time-division multiplex communication terminals, whereby the control signals can represent a first or a second status; offering a fixed data pattern; transmitting the ATM cells coming from the ATM communication layer into an ATM cell waiting list; transmitting, on demand, an ATM cell from the ATM waiting list to the requesting time-division multiplex communication terminal when the respectively oldest control signal of the control signal sequence represents the first status, and transmitting the fixed data pattern to the requesting time-division multiplex communication terminal when the oldest control signal of the control signal sequence represents the second status; and deleting the oldest control signal of the control signal sequence. The method enables a frictionless coupling of an ATM communication layer having a plurality of mutually independent time-division multiplex communication terminals, whereby variable data rates (burst behavior) of the ATM layer as well as of the time-division multiplex communication terminals can be decoupled from one another and good cell delay variation (CDV) properties can be assured.

Figure 1

FIG 1

LAYER
ATM-Schicht

ATM-Zellen
CELLS

QUEUE
ATM-Warteschlange

| ATM | ATM |
| ATM | ATM |

F

festes Datenmuster
FIXED DATA PATTERN

| 1 | 0 | 1 | 1 |

~
CLK

Steuersignal-
sequenz-
CONTROL SIGNAL
SEQUENCE

N ports

N

2
1

Declaration and Power of Attorney For Patent Application
Erklärung Für Patentanmeldungen Mit Vollmacht
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

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Verfahren und Vorrichtung zur Ankopplung einer ATM-Kommunikationsschicht an meh-rere Zeitmultiplex-Kommunikationsan-schlüsse

deren Beschreibung

(zutreffendes ankreuzen)

[X] hier beigefügt ist.

[ ] am _____ als
PCT internationale Anmeldung
PCT Anmeldungsnummer _____
eingereicht wurde und am _____
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Ich beanspruche hiermit ausländische Prioritätsvor-teile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten ange-gebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslands-anmeldungen für ein Patent oder eine Erfindersurkun-de nachstehend gekennzeichnet, die ein Anmelde-datum haben, das vor dem Anmeldedatum der An-meldung liegt, für die Priorität beansprucht wird

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

_____
_____
_____

_____

the specification of which

(check one)

[ ] is attached hereto.

[ ] was filed on _____ as
PCT international application
PCT Application No. _____
and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, inclu-ding the claims as amended by any amendment refer-red to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regula-tions, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is clai-med:

German Language Declaration

Prior foreign appplications
Priorität beansprucht

Priority Claimed

<u>198 15 605.7</u> ⌐ <u>Germany ⌐</u>		<u>07. April 1998</u> ✓	☒ Yes Ja	☐ No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)		

			☐ Yes Ja	☐ No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)		

			☐ Yes Ja	☐ No Nein
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)		

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Serial No.) (Anmeldeseriennummer)	(Filing Date) (Anmeldedatum)

(Status) (patentiert, anhängig, aufgegeben)	(Status) (patented, pending, abandoned)

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

And I hereby appoint

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Unterschrift des Erfinders · Datum	Second Inventor's signature · Date
Wohnsitz	Residence
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Change Of Attorney Or Agent's Address In Application (37 CFR 1.8(a))	430 Rec'd PCT/PTO 24 OCT 2000	Docket No.

In Re Application Of: **Andreas Klug**

Serial No.	Filing Date	Examiner	Group Art Unit

Invention: **METHOD AND APPARATUS FOR COUPLING AN ATM COMMUNICATION LAYER TO A PLURALITY OF TIME-DIVISION MULTIPLEX COMMUNICATIONS TERMINALS**

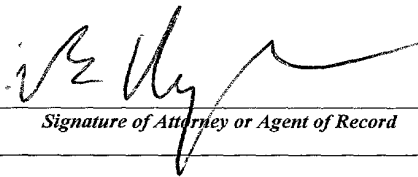TO THE ASSISTANT COMMISSIONER FOR PATENTS

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Signature of Attorney or Agent of Record

Dated: **October 2, 2000**

William E. Vaughan (Reg. No. 39,056) **Bell, Boyd & Lloyd LLC** **P.O. Box 1135** **Chicago, Illinois 60690-1135**	I certify that this document is being deposited on _____ with the U.S. Postal Service as first class mail under 37 C.F.R. 1.8 and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.
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